

What is claimed is

1. A method of protecting an exposed copper surface of a partially fabricated IC from oxidation during exposure to an oxygen-containing environment, the method comprising:
 - contacting the exposed copper surface with a metallocene compound; and
 - contacting the exposed copper surface with the oxygen-containing environment, whereby exposure to the metallocene compound minimizes formation of copper oxide on the exposed copper surface.
2. The method of claim 1, wherein the metallocene contains a metal selected from the group consisting of ruthenium, cobalt, nickel, iron, palladium, platinum, titanium, chromium, osmium, manganese, and cobalt.
3. The method of claim 1, wherein the metallocene is ruthenocene.
4. The method of claim 1, wherein contacting the exposed copper surface with a metallocene compound comprises flowing a gas containing metallocene over the partially fabricated IC.
5. The method of claim 1, wherein contacting the exposed copper surface with the oxygen-containing environment comprises contacting the exposed copper surface with a compound that forms a solid phase layer on the partially fabricated IC.
- 5a. The method of claim 5, wherein the compound is a precursor compound that reacts with an oxygen-containing species to form the solid phase layer.
6. The method of claim 1, wherein contacting the exposed copper surface with the oxygen-containing environment comprises contacting the exposed copper surface with a diffusion barrier precursor, which reacts with an oxygen-containing species to form a barrier layer on the partially fabricated IC.
7. The method of claim 6, wherein the oxygen-containing species is molecular oxygen.
8. The method of claim 1, wherein contacting the exposed copper surface with the oxygen-containing environment comprises contacting the exposed copper surface

with an etch stop precursor, which reacts with an oxygen-containing species to form an etch stop layer on the partially fabricated IC.

9. The method of claim 1, wherein contacting the exposed copper surface with the oxygen-containing environment comprises contacting the exposed copper with the ambient or other oxygen-containing environment during storage or transport between processing modules.

10. The method of claim 1, wherein the exposed copper surface comprises a copper seed layer on the partially fabricated IC.

11. A method of passivating and using an exposed copper surface of a partially fabricated IC, the method comprising:

contacting the exposed copper surface with a metallocene compound to thereby passivate the surface; and

depositing a layer of material on the partially fabricated IC using an oxygen-containing deposition chemistry.

12. The method of claim 11 further comprising performing the contacting and depositing step in a single chamber.

13. The method of claim 11 wherein the depositing is conducted using the metallocene compound as a chemical precursor to the material.

14. The method of claim 11 wherein the contacting and depositing operations are done concurrently.

15. The method of claim 11, wherein the metallocene is contains a metal selected from the group consisting of ruthenium, cobalt, nickel, iron, palladium, platinum, titanium, chromium, osmium, manganese, and cobalt.

16. The method of claim 11, wherein the metallocene is ruthenocene.

17. The method of claim 11, wherein contacting the exposed copper surface with a metallocene compound comprises flowing a gas containing metallocene over partially fabricated IC.

18. The method of claim 11, wherein the depositing of a layer of material comprises contacting the exposed copper surface with a compound that forms a solid phase layer on the partially fabricated IC.
19. The method of claim 11, wherein the depositing of a layer of material comprises contacting the exposed copper surface with a diffusion barrier precursor, which reacts with an oxygen-containing species to form a barrier layer on the partially fabricated IC.
20. The method of claim 19, wherein the oxygen-containing species is molecular oxygen.
21. The method of claim 11, wherein depositing a layer of material comprises contacting the exposed copper surface with an etch stop precursor, which reacts with an oxygen-containing species to form an etch stop layer on the partially fabricated IC.
22. The method of claim 11, wherein the exposed copper surface comprises a copper seed layer on the partially fabricated IC.